



SEQUENCE LISTING

<110> FULTON, CHANDLER
LAI, ELAINE Y.

<120> THIAMINASES AND THIAMINASE GENES FOR USE IN APOPTOTIC
THERAPIES

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<140> 09/675,509

<141> 2000-09-29

<150> 60/052,377

<151> 1997-07-11

<150> 60/087,526

<151> 1998-06-01

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<170> PatentIn Ver. 2.1

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Phe Ser Thr Asp Ser Ile Phe Leu Pro Tyr Leu Val Ser Leu Gly Gly
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Val Lys Ser Leu Asp Glu Ser Leu Val Arg Gly Val Thr Gly Asp Leu
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His Ser Phe Val Ser Ser Ser Ala Ser Val Asn Gly Ser Val Tyr Gly
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| 130 | | | | | | 135 | | | | | 140 | | | | | | |
| Glu | Gln | Ile | Val | Tyr | Pro | Asp | Val | Ala | Ser | Ser | Ser | Ser | Phe | Thr | Val | | |
| 145 | | | | | 150 | | | | | 155 | | | | | | 160 | |
| Phe | Gly | Leu | Tyr | Gln | Gln | Leu | Leu | Gln | Ser | Ser | Ser | Ser | Ala | Ala | Val | | |
| | | | | 165 | | | | | 170 | | | | | | 175 | | |
| Asp | Ile | Lys | Ala | Ser | Asp | Leu | Pro | Gln | Ser | Gly | Asp | Gln | Val | Asn | Lys | | |
| | | | 180 | | | | | 185 | | | | | 190 | | | | |
| Asp | Ile | Thr | Gln | Lys | Tyr | Arg | Thr | Ile | Leu | Asp | Ser | Thr | Val | Val | Ala | | |
| | 195 | | | | | | 200 | | | | | 205 | | | | | |
| Ser | Gln | Arg | Glu | Tyr | Ile | Asn | Ser | Val | Lys | Gln | Gly | Lys | Pro | Ile | Ser | | |
| | 210 | | | | | 215 | | | | | 220 | | | | | | |
| Asn | Tyr | Tyr | Val | Gly | Tyr | Ser | Glu | Ser | Met | Cys | Glu | Ile | Lys | Asp | Ile | | |
| 225 | | | | | 230 | | | | | 235 | | | | | 240 | | |
| Ile | Arg | Asp | Gln | Gln | Tyr | Asn | Val | Gln | Leu | Ile | Gly | Thr | Ser | Asp | Lys | | |
| | | | 245 | | | | | | 250 | | | | | 255 | | | |
| Pro | Tyr | Val | Tyr | Thr | Asp | Val | Leu | Ala | Leu | Asn | Ser | Asn | Leu | Cys | Asp | | |
| | | | 260 | | | | | 265 | | | | | 270 | | | | |
| Glu | Lys | Gln | Lys | Val | Ala | Val | Glu | Val | Ile | Lys | Asn | Leu | Leu | Thr | Asn | | |
| | | 275 | | | | | 280 | | | | | 285 | | | | | |
| Thr | Leu | Val | Leu | Asp | Leu | Leu | Gly | Leu | Gly | Leu | Thr | Leu | Pro | Ala | Asn | | |
| | 290 | | | | | 295 | | | | | 300 | | | | | | |
| Lys | Asn | Gly | Ile | Ala | His | Leu | Ala | Lys | Ser | Ser | Asn | Phe | Tyr | Ala | Gln | | |
| 305 | | | | | 310 | | | | | 315 | | | | | 320 | | |
| Leu | Ser | Gln | Gln | Phe | Asp | Ala | Lys | Glu | Ser | Glu | Val | Arg | Val | Leu | Arg | | |
| | | | | 325 | | | | | 330 | | | | | 335 | | | |
| Cys | Val | Asp | Phe | Ala | Asn | Lys | Glu | Val | Lys | Asn | Cys | Ala | Gly | Val | Leu | | |
| | | | 340 | | | | | 345 | | | | | 350 | | | | |
| Arg | Pro | Phe | Leu | Gln | His | Ile | Ala | Val | Ala | Thr | Leu | Arg | Cys | Leu | Thr | | |
| | | 355 | | | | | 360 | | | | | 365 | | | | | |
| Ala | Asp | Thr | Val | Glu | Lys | Ala | Lys | Ser | Gly | His | Pro | Gly | Met | Pro | Ile | | |
| | 370 | | | | | 375 | | | | | 380 | | | | | | |
| Gly | Met | Ser | Pro | Ile | Ala | Tyr | Val | Leu | Trp | Lys | Phe | Phe | Phe | Lys | Ser | | |
| 385 | | | | | 390 | | | | | 395 | | | | | 400 | | |
| Ser | Lys | Asp | Asp | Val | Asn | Trp | Leu | Asn | Arg | Asp | Arg | Phe | Val | Leu | Ser | | |
| | | | | 405 | | | | | 410 | | | | | 415 | | | |
| Asn | Gly | His | Gly | Cys | Thr | Leu | Leu | Tyr | Ala | Met | Leu | His | Leu | Thr | Asp | | |
| | | | 420 | | | | | 425 | | | | | 430 | | | | |

| | | | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Cys | Asn | Leu | Ser | Leu | Asp | Asp | Leu | Lys | Asn | Phe | Arg | Ser | Leu | His | Ser | 435 | 440 | 445 |
| Lys | Thr | Pro | Gly | His | Pro | Glu | Tyr | Gly | His | Thr | Glu | Gly | Val | Asp | Ala | 450 | 455 | 460 |
| Thr | Thr | Gly | Pro | Leu | Gly | Gln | Gly | Val | Cys | Asn | Ala | Ile | Gly | Met | Ala | 465 | 470 | 475 |
| Leu | Ser | Glu | Ala | His | Leu | Ala | Ala | Arg | Phe | Asn | Lys | Asp | Gly | Gln | Asn | 485 | 490 | 495 |
| Ile | Phe | Asp | His | His | Thr | Tyr | Val | Phe | Leu | Gly | Asp | Gly | Cys | Leu | Met | 500 | 505 | 510 |
| Glu | Arg | Val | Ala | Met | Glu | Gly | Leu | Ser | Phe | Ala | Gly | His | Gln | Lys | Leu | 515 | 520 | 525 |
| Asn | Lys | Leu | Ile | Val | Phe | Tyr | Asp | Asp | Asn | Ser | Ile | Thr | Ile | Asp | Gly | 530 | 535 | 540 |
| Lys | Thr | Glu | Leu | Thr | Phe | Thr | Gln | Asn | Thr | Pro | Glu | Val | Met | Arg | Gly | 545 | 550 | 555 |
| Phe | Gly | Trp | His | Val | Ile | Val | Val | Asp | Lys | Ala | Asp | Asn | Asp | Leu | Val | 565 | 570 | 575 |
| Gly | Ile | Lys | Glu | Ala | Ile | Leu | Glu | Ala | His | Thr | Val | Thr | Asp | Lys | Pro | 580 | 585 | 590 |
| Ile | Met | Ile | Val | Cys | Lys | Thr | Thr | Ile | Gly | Tyr | Ser | Ser | Lys | Val | Gln | 595 | 600 | 605 |
| Gly | Thr | Ala | Lys | Val | His | Gly | Ser | Pro | Leu | Gly | Ala | Asp | Gly | Leu | Lys | 610 | 615 | 620 |
| Asn | Leu | Lys | Glu | Thr | Cys | Gly | Phe | Thr | Gly | Asn | Asp | Phe | Phe | His | Val | 625 | 630 | 635 |
| Pro | Glu | Ile | Val | Arg | Lys | Asp | Phe | Ala | Thr | Val | Ile | Asn | Arg | Asn | Ser | 645 | 650 | 655 |
| Glu | Lys | Leu | Ser | Gln | Trp | Lys | Gln | Val | Lys | Ser | Ala | Tyr | Asp | Thr | Thr | 660 | 665 | 670 |
| His | Ala | Thr | Glu | Ser | Gln | Leu | Leu | Gln | Arg | Met | Ile | Asn | His | Glu | Leu | 675 | 680 | 685 |
| Glu | Gly | Asp | Val | Met | Glu | Lys | Leu | Pro | Lys | Tyr | Leu | Glu | Gln | Lys | Lys | 690 | 695 | 700 |
| Ile | Ala | Thr | Arg | Ser | Thr | Ser | Gln | Gln | Val | Leu | Asn | Ala | Ile | Tyr | Pro | 705 | 710 | 715 |
| Leu | Ile | Pro | Ser | Leu | Val | Gly | Gly | Ser | Ala | Asp | Leu | Thr | Pro | Ser | Asn | 725 | 730 | 735 |

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 755 760 765
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 770 775 780
 Phe Leu Asn Phe Ala Ser Tyr Ala Leu Gly Ala Ile Arg Leu Ser Ala
 785 790 795 800
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 805 810 815
 Leu Gly Gln Asp Gly Pro Thr His Gln Pro Val Glu Val Leu Pro Met
 820 825 830
 Leu Ile Ala Ile Pro Asn His Ile Val Phe Arg Pro Ala Asp Gly Arg
 835 840 845
 Glu Thr Ser Gly Ala Tyr Leu Trp Ala Val Gln Ser Lys Lys Thr Pro
 850 855 860
 Ser Ser Met Ile Leu Ser Arg Gln Asp Leu Pro Gln Leu Thr Gly Thr
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 Asp Ile Ser Lys Val Ala Leu Gly Ala Tyr Val Ile Gln Gly Asp Ala
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 Val Glu Ala Ala Glu Lys Leu Lys Ala Asn Leu Lys Val Asn Val Val
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 Lys Thr Val Phe Pro Asp Gly Ile Pro Val Val Ser Ala Glu Ala Ser
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 Leu
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 Lys Asp Val Leu Pro Thr Gln Val Ser Gly Tyr Asn Ile Glu Tyr Thr
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 Phe Ser Thr Asp Ser Ile Phe Leu Pro Tyr Leu Val Ser Leu Gly Gly
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 Val Lys Ser Leu Asp Glu Ser Leu Val Arg Gly Val Thr Gly Asp Leu
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 Phe Pro Gln Tyr Leu Cys Ser Asn Phe Leu Leu Ser Ser Pro Asn Gly
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| 195 200 205 | |
| tct caa aga gaa tat att aac tct gta aag caa ggt aaa cca att tca | 672 |
| Ser Gln Arg Glu Tyr Ile Asn Ser Val Lys Gln Gly Lys Pro Ile Ser | |
| 210 215 220 | |
| aac tac tat gtc gga tat agt gaa agt atg tgt gaa att aag gat atc | 720 |
| Asn Tyr Tyr Val Gly Tyr Ser Glu Ser Met Cys Glu Ile Lys Asp Ile | |
| 225 230 235 240 | |
| atc aga gat caa caa tac aat gtt caa ctc att ggt acc tct gat aag | 768 |
| Ile Arg Asp Gln Gln Tyr Asn Val Gln Leu Ile Gly Thr Ser Asp Lys | |
| 245 250 255 | |
| cca tac gtt tat act gat gtt ttg gct ttg aat tcc aat ttg tgt gat | 816 |
| Pro Tyr Val Tyr Thr Asp Val Leu Ala Leu Asn Ser Asn Leu Cys Asp | |
| 260 265 270 | |
| gaa aag caa aag gtt gct gtt gaa gtt atc aag aat tta ttg act aat | 864 |
| Glu Lys Gln Lys Val Ala Val Glu Val Ile Lys Asn Leu Leu Thr Asn | |
| 275 280 285 | |
| act tta gtt ttg gac ttg ttg ggt ctc gga tta act ctc cca gcc aac | 912 |
| Thr Leu Val Leu Asp Leu Leu Gly Leu Gly Leu Thr Leu Pro Ala Asn | |
| 290 295 300 | |
| aag aat ggt att gct cat ttg gct aaa tca tca aac ttt tat gct caa | 960 |
| Lys Asn Gly Ile Ala His Leu Ala Lys Ser Ser Asn Phe Tyr Ala Gln | |
| 305 310 315 320 | |
| ttg agc caa caa ttc gat gcc aag gaa agt gaa gtt aga gtt ttg aga | 1008 |
| Leu Ser Gln Gln Phe Asp Ala Lys Glu Ser Glu Val Arg Val Leu Arg | |
| 325 330 335 | |
| tgt gtt gac ttt gct aac aag gaa gtt aag aat tgt gct ggt gtc ttg | 1056 |
| Cys Val Asp Phe Ala Asn Lys Glu Val Lys Asn Cys Ala Gly Val Leu | |
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| aga cca ttc ctt | 1068 |
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<212> PRT

<213> Naegleria gruberi

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 Glu Phe Asp Cys Tyr Ser Asp Ala Ser Leu Gln Ser Leu Pro Asp Val
 50 55 60
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 65 70 75 80
 Val Lys Ser Leu Asp Glu Ser Leu Val Arg Gly Val Thr Gly Asp Leu
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 His Ser Phe Val Ser Ser Ser Ala Ser Val Asn Gly Ser Val Tyr Gly
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 Phe Pro Gln Tyr Leu Cys Ser Asn Phe Leu Leu Ser Ser Pro Asn Gly
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 Thr Gln Gln Ala Ser Ser Leu Leu Glu Leu Ala Gln Lys Val Gly Tyr
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 Glu Gln Ile Val Tyr Pro Asp Val Ala Ser Ser Ser Ser Phe Thr Val
 145 150 155 160
 Phe Gly Leu Tyr Gln Gln Leu Leu Gln Ser Ser Ser Ser Ala Ala Val
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 Asp Ile Lys Ala Ser Asp Leu Pro Gln Ser Gly Asp Gln Val Asn Lys
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 245 250 255
 Pro Tyr Val Tyr Thr Asp Val Leu Ala Leu Asn Ser Asn Leu Cys Asp
 260 265 270
 Glu Lys Gln Lys Val Ala Val Glu Val Ile Lys Asn Leu Leu Thr Asn
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 Lys Asn Gly Ile Ala His Leu Ala Lys Ser Ser Asn Phe Tyr Ala Gln
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Ser Glu Tyr Gln Lys Lys Phe Pro Glu Leu Gly Ala Glu Leu Ala Arg
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Arg Leu Ser Gly Gln Leu Pro Ala Asn Trp Glu Ser Lys Leu Pro Thr
 65 70 75 80

Tyr Thr Ala Lys Asp Ser Ala Val Ala Thr Arg Lys Leu Ser Glu Thr
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Val Leu Glu Asp Val Tyr Asn Gln Leu Pro Glu Leu Ile Gly Gly Ser
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Ala Asp Leu Thr Pro Ser Asn Leu Thr Arg Trp Lys Glu Ala Leu Asp
 115 120 125

Phe Gln Pro Pro Ser Ser Gly Ser Gly Asn Tyr Ser Gly Arg Tyr Ile
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Arg Tyr Gly Ile Arg Glu His Ala Met Gly Ala Ile Met Asn Gly Ile
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 165 170 175

Phe Val Ser Tyr Ala Ala Gly Ala Val Arg Leu Ser Ala Leu Ser Gly
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His Pro Val Ile Trp Val Ala Thr His Asp Ser Ile Gly Val Gly Glu
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Asp Gly Pro Thr His Gln Pro Ile Glu Thr Leu Ala His Phe Arg Ser
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Leu Pro Asn Ile Gln Val Trp Arg Pro Ala Asp Gly Asn Glu Val Ser
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Ala Ala Tyr Lys Asn Ser Leu Glu Ser Lys His Thr Pro Ser Ile Ile
245 250 255

Ala Leu Ser Arg Gln Asn Leu Pro Gln Leu Glu Gly Ser Ser Ile Glu
260 265 270

Ser Ala Ser Lys Gly Gly Tyr Val Leu Gln Asp Val Ala Asn Pro Asp
275 280 285

Ile Ile Leu Val Ala Thr Gly Ser Glu Val Ser Leu Ser Val Glu Ala
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Ala Lys Thr Leu Ala Ala Lys Asn Ile Lys Ala Arg Val Val Ser Leu
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Pro Asp Phe Phe Thr Phe Asp Lys Gln Pro Leu Glu Tyr Arg Leu Ser
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Val Leu Pro Asp Asn Val Pro Ile Met Ser Val Glu Val Leu Ala Thr
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Thr Cys Trp Gly Lys Tyr Ala His Gln Ser Phe Gly Ile Asp Arg Phe
355 360 365

Gly Ala Ser Gly Lys Ala Pro Glu Val Phe Lys Phe Phe Gly Phe Thr
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<212> PRT

<213> Craterostigma plantagineum

<400> 6

Pro Lys Glu Ala Glu Ala Thr Arg Lys Asn Leu Gly Trp Pro Tyr Glu
1 5 10 15

Pro Phe His Val Pro Asp Asp Val Lys Lys His Trp Ser Arg His Ile
20 25 30

Ala Glu Gly Ala Ala Leu Glu Ser Ala Trp Asn Ala Lys Phe Ala Glu
35 40 45

Phe Gln Lys Lys Phe Pro Glu Glu Ala Ala Asp Leu Lys Ser Ile Ile
50 55 60

Thr Gly Glu Leu Pro Thr Asn Trp Glu Ser Ile Phe Pro Thr Tyr Thr
65 70 75 80

Pro Glu Asn Pro Gly Leu Pro Thr Arg Thr Leu Ser His Gln Ile Leu
85 90 95

| | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|
| Asn | Gly | Leu | Gly | Asp | Val | Leu | Pro | Gly | Leu | Leu | Gly | Gly | Ser | Ala | Asp | |
| | | | 100 | | | | | 105 | | | | | 110 | | | |
| Leu | Thr | Leu | Ser | Asn | Met | Ala | Phe | Leu | Lys | Asn | Ser | Gly | Asp | Phe | Gln | |
| | | 115 | | | | | 120 | | | | | 125 | | | | |
| Lys | Lys | Ser | Pro | Gly | Glu | Arg | Asn | Val | Lys | Phe | Gly | Ala | Arg | Glu | His | |
| | 130 | | | | | 135 | | | | | 140 | | | | | |
| Ala | Met | Gly | Ser | Ile | Cys | Asn | Gly | Leu | Ala | Leu | His | Ser | Pro | Gly | Leu | |
| 145 | | | | | 150 | | | | | 155 | | | | | 160 | |
| Leu | Pro | Tyr | Cys | Ala | Thr | Tyr | Phe | Val | Phe | Thr | Asp | Tyr | Met | Arg | Ala | |
| | | | | 165 | | | | | 170 | | | | | 175 | | |
| Ala | Met | Arg | Ile | Ser | Ala | Leu | Ser | Lys | Ala | Arg | Val | Leu | Tyr | Ile | Met | |
| | | | 180 | | | | | 185 | | | | | 190 | | | |
| Thr | His | Asp | Ser | Ile | Gly | Leu | Gly | Glu | Asp | Gly | Pro | Thr | His | Gln | Pro | |
| | | 195 | | | | | 200 | | | | | 205 | | | | |
| Val | Glu | His | Leu | Ala | Ser | Phe | Arg | Ala | Met | Pro | Asn | Ile | Leu | Thr | Leu | |
| | 210 | | | | | 215 | | | | | 220 | | | | | |
| Arg | Pro | Ala | Asp | Gly | Asn | Glu | Thr | Ala | Gly | Ala | Tyr | Arg | Ala | Ala | Val | |
| 225 | | | | | 230 | | | | | 235 | | | | | 240 | |
| Gln | Asn | Gly | Glu | Arg | Pro | Ser | Ile | Leu | Val | Leu | Ala | Arg | Gln | Lys | Leu | |
| | | | | 245 | | | | | 250 | | | | | 255 | | |
| Pro | Gln | Leu | Pro | Gly | Thr | Ser | Ile | Glu | Gly | Val | Ser | Lys | Gly | Gly | Tyr | |
| | | 260 | | | | | | 265 | | | | | 270 | | | |
| Val | Ile | Ser | Asp | Asn | Ser | Arg | Gly | Gly | Asn | Ser | Lys | Pro | Asp | Val | Ile | |
| | | 275 | | | | | 280 | | | | | 285 | | | | |
| Leu | Ile | Gly | Thr | Gly | Ser | Glu | Leu | Glu | Ile | Ala | Ala | Arg | Ala | Gly | Asp | |
| | 290 | | | | | 295 | | | | 300 | | | | | | |
| Glu | Leu | Arg | Lys | Glu | Gly | Lys | Lys | Val | Arg | Val | Val | Ser | Leu | Val | Cys | |
| 305 | | | | | 310 | | | | | 315 | | | | | 320 | |
| Trp | Glu | Leu | Phe | Ala | Glu | Gln | Ser | Glu | Lys | Tyr | Arg | Glu | Thr | Val | Leu | |
| | | | | 325 | | | | | 330 | | | | | 335 | | |
| Pro | Ser | Gly | Val | Thr | Ala | Arg | Val | Ser | Val | Glu | Ala | Gly | Ser | Thr | Phe | |
| | | | 340 | | | | | 345 | | | | | 350 | | | |
| Gly | Trp | Glu | Arg | Phe | Ile | Gly | Pro | Lys | Gly | Lys | Ala | Val | Gly | Ile | Asp | |
| | | 355 | | | | | 360 | | | | | 365 | | | | |
| Arg | Phe | Gly | Ala | Ser | Ala | Pro | Ala | Glu | Arg | Leu | Phe | Lys | Glu | Phe | Gly | |
| | 370 | | | | | 375 | | | | | 380 | | | | | |
| Ile | Thr | Val | Glu | Ala | Val | Val | Ala | Ala | Ala | Lys | Glu | Ile | Cys | | | |
| 385 | | | | | 390 | | | | | 395 | | | | | | |

<210> 7

<211> 402

<212> PRT

<213> Escherichia coli

<400> 7

| | | | | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Glu | Glu | Glu | Val | Ala | Leu | Ala | Arg | Gln | Lys | Leu | Gly | Trp | His | His | Pro | 1 | 5 | 10 | 15 |
| Pro | Phe | Glu | Ile | Pro | Lys | Glu | Ile | Tyr | His | Ala | Trp | Asp | Ala | Arg | Glu | 20 | 25 | 30 | |
| Lys | Gly | Glu | Lys | Ala | Gln | Gln | Ser | Trp | Asn | Glu | Lys | Phe | Ala | Ala | Tyr | 35 | 40 | 45 | |
| Lys | Lys | Ala | His | Pro | Gln | Leu | Ala | Glu | Glu | Phe | Thr | Arg | Arg | Met | Ser | 50 | 55 | 60 | |
| Gly | Gly | Leu | Pro | Lys | Asp | Trp | Glu | Lys | Thr | Thr | Gln | Lys | Tyr | Ile | Asn | 65 | 70 | 75 | 80 |
| Glu | Leu | Gln | Ala | Asn | Pro | Ala | Lys | Ile | Ala | Thr | Arg | Lys | Ala | Ser | Gln | 85 | 90 | 95 | |
| Asn | Thr | Leu | Asn | Ala | Tyr | Gly | Pro | Met | Leu | Pro | Glu | Leu | Leu | Gly | Gly | 100 | 105 | 110 | |
| Ser | Ala | Asp | Leu | Ala | Pro | Ser | Asn | Leu | Thr | Ile | Trp | Lys | Gly | Ser | Val | 115 | 120 | 125 | |
| Ser | Leu | Lys | Glu | Asp | Pro | Ala | Gly | Asn | Tyr | Ile | His | Tyr | Gly | Val | Arg | 130 | 135 | 140 | |
| Glu | Phe | Gly | Met | Thr | Ala | Ile | Ala | Asn | Gly | Ile | Ala | His | His | Gly | Gly | 145 | 150 | 155 | 160 |
| Phe | Val | Pro | Tyr | Thr | Ala | Thr | Phe | Leu | Met | Phe | Val | Glu | Tyr | Ala | Arg | 165 | 170 | 175 | |
| Asn | Ala | Ala | Arg | Met | Ala | Ala | Leu | Met | Lys | Ala | Arg | Gln | Ile | Met | Val | 180 | 185 | 190 | |
| Tyr | Thr | His | Asp | Ser | Ile | Gly | Leu | Gly | Glu | Asp | Gly | Pro | Thr | His | Gln | 195 | 200 | 205 | |
| Ala | Val | Glu | Gln | Leu | Ala | Ser | Leu | Arg | Leu | Thr | Pro | Asn | Phe | Ser | Thr | 210 | 215 | 220 | |
| Trp | Arg | Pro | Cys | Asp | Gln | Val | Glu | Ala | Ala | Val | Gly | Trp | Lys | Leu | Ala | 225 | 230 | 235 | 240 |
| Val | Glu | Arg | His | Asn | Gly | Pro | Thr | Ala | Leu | Ile | Leu | Ser | Arg | Gln | Asn | 245 | 250 | 255 | |
| Leu | Ala | Gln | Val | Glu | Arg | Thr | Pro | Asp | Gln | Val | Lys | Glu | Ile | Ala | Arg | 260 | 265 | 270 | |

Gly Gly Tyr Val Leu Lys Asp Ser Gly Gly Lys Pro Asp Ile Ile Leu
 275 280 285
 Ile Ala Thr Gly Ser Glu Met Glu Ile Thr Leu Gln Ala Ala Glu Lys
 290 300
 Leu Ala Gly Glu Gly Arg Asn Val Arg Val Val Ser Leu Pro Ser Thr
 305 310 315 320
 Asp Ile Phe Asp Ala Gln Asp Glu Glu Tyr Arg Glu Ser Val Leu Pro
 325 330 335
 Ser Asn Val Ala Ala Arg Val Ala Val Glu Ala Gly Ile Ala Asp Tyr
 340 345 350
 Trp Tyr Lys Tyr Val Gly Leu Lys Gly Ala Ile Val Gly Met Thr Gly
 355 360 365
 Tyr Gly Glu Ser Ala Pro Ala Asp Lys Leu Phe Pro Phe Phe Gly Phe
 370 375 380
 Thr Ala Glu Asn Ile Val Ala Lys Ala His Lys Val Leu Gly Val Lys
 385 390 395 400
 Gly Ala

<210> 8
 <211> 400
 <212> PRT
 <213> Bacillus subtilis

<400> 8
 Lys Glu Glu Ser Lys Leu Thr Lys Glu Ala Tyr Ala Trp Thr Tyr Glu
 1 5 10 15
 Glu Asp Phe Tyr Val Pro Ser Glu Val Tyr Glu His Phe Ala Val Ala
 20 25 30
 Val Lys Glu Ser Gly Glu Lys Lys Glu Gln Glu Trp Asn Ala Gln Phe
 35 40 45
 Ala Lys Tyr Lys Glu Val Tyr Pro Glu Leu Ala Glu Gln Leu Glu Leu
 50 55 60
 Ala Ile Lys Gly Glu Leu Pro Lys Asp Trp Asp Gln Glu Val Pro Val
 65 70 75 80
 Tyr Glu Lys Gly Ser Ser Leu Ala Ser Arg Ala Ser Ser Gly Glu Val
 85 90 95
 Leu Asn Gly Leu Ala Lys Lys Ile Pro Phe Phe Val Gly Gly Ser Ala
 100 105 110
 Asp Leu Ala Gly Ser Asn Lys Thr Thr Ile Lys Asn Ala Gly Asp Phe
 115 120 125

Thr Ala Val Asp Tyr Ser Gly Lys Asn Phe Trp Phe Gly Val Arg Glu
 130 135 140
 Phe Ala Met Gly Ala Ala Leu Asn Gly Met Ala Leu His Gly Gly Leu
 145 150 155 160
 Arg Val Phe Gly Gly Thr Phe Phe Val Phe Ser Asp Tyr Leu Arg Pro
 165 170 175
 Ala Ile Arg Leu Ala Ala Leu Met Gly Leu Pro Val Thr Tyr Val Phe
 180 185 190
 Thr His Asp Ser Ile Ala Val Gly Glu Asp Gly Pro Thr His Glu Pro
 195 200 205
 Val Glu Gln Leu Ala Ser Leu Arg Ala Met Pro Asn Leu Ser Leu Ile
 210 215 220
 Arg Pro Ala Asp Gly Asn Glu Thr Ala Ala Ala Trp Lys Leu Ala Val
 225 230 235 240
 Gln Ser Thr Asp His Pro Thr Ala Leu Val Leu Thr Arg Gln Asn Leu
 245 250 255
 Pro Thr Ile Asp Gln Thr Ser Glu Glu Ala Leu Ala Gly Val Glu Lys
 260 265 270
 Gly Ala Tyr Val Val Ser Lys Ser Lys Asn Glu Thr Pro Asp Ala Leu
 275 280 285
 Leu Ile Ala Ser Gly Ser Glu Val Gly Leu Ala Ile Glu Ala Gln Ala
 290 295 300
 Glu Leu Ala Lys Glu Asn Ile Asp Val Ser Val Val Ser Met Pro Ser
 305 310 315 320
 Met Asp Arg Phe Glu Lys Gln Ser Asp Glu Tyr Lys Asn Glu Val Leu
 325 330 335
 Pro Ala Asp Val Lys Lys Arg Leu Ala Ile Glu Met Gly Ser Ser Phe
 340 345 350
 Gly Trp Gly Lys Tyr Thr Gly Leu Glu Gly Asp Val Leu Gly Ile Asp
 355 360 365
 Arg Phe Gly Ala Ser Ala Pro Gly Glu Thr Ile Ile Asn Glu Tyr Gly
 370 375 380
 Phe Ser Val Pro Asn Val Val Asn Arg Val Lys Ala Leu Ile Asn Lys
 385 390 395 400

<210> 9

<211> 391

<212> PRT

<213> Mycoplasma genitalium

<400> 9

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Glu | Val | Asp | Phe | Gln | Leu | Phe | Glu | Lys | Arg | Thr | Asn | Thr | Asn | Phe | Asn |
| 1 | | | | 5 | | | | | 10 | | | | | 15 | |
| Phe | Phe | Asn | Tyr | Pro | Asp | Ser | Ile | Tyr | His | Trp | Phe | Lys | Gln | Thr | Val |
| | | 20 | | | | | | 25 | | | | | 30 | | |
| Ile | Glu | Arg | Gln | Lys | Gln | Ile | Lys | Glu | Asp | Tyr | Asn | Asn | Leu | Leu | Ile |
| | | 35 | | | | | 40 | | | | | 45 | | | |
| Ser | Leu | Lys | Asp | Lys | Pro | Leu | Phe | Lys | Lys | Phe | Thr | Asn | Trp | Ile | Asp |
| | 50 | | | | | 55 | | | | | 60 | | | | |
| Ser | Asp | Phe | Gln | Ala | Leu | Tyr | Leu | Asn | Gln | Leu | Asp | Glu | Lys | Lys | Val |
| 65 | | | | | 70 | | | | | 75 | | | | | 80 |
| Ala | Lys | Lys | Asp | Ser | Ala | Thr | Arg | Asn | Tyr | Leu | Lys | Asp | Phe | Leu | Asn |
| | | | | 85 | | | | | 90 | | | | | 95 | |
| Gln | Ile | Asn | Asn | Pro | Asn | Ser | Asn | Leu | Tyr | Cys | Leu | Asn | Ala | Asp | Val |
| | | 100 | | | | | | 105 | | | | | 110 | | |
| Ser | Arg | Ser | Cys | Phe | Ile | Lys | Ile | Gly | Asp | Asp | Asn | Leu | His | Glu | Asn |
| | 115 | | | | | | 120 | | | | | 125 | | | |
| Pro | Cys | Ser | Arg | Asn | Ile | Gln | Ile | Gly | Ile | Arg | Glu | Phe | Ala | Met | Ala |
| | 130 | | | | | 135 | | | | | 140 | | | | |
| Thr | Ile | Met | Asn | Gly | Met | Ala | Leu | His | Gly | Gly | Ile | Lys | Val | Met | Gly |
| 145 | | | | | 150 | | | | | 155 | | | | | 160 |
| Gly | Thr | Phe | Leu | Ala | Phe | Ala | Asp | Tyr | Ser | Lys | Pro | Ala | Ile | Arg | Leu |
| | | | 165 | | | | | | 170 | | | | | 175 | |
| Gly | Ala | Leu | Met | Asn | Leu | Pro | Val | Phe | Tyr | Val | Tyr | Thr | His | Asp | Ser |
| | | 180 | | | | | | 185 | | | | | 190 | | |
| Tyr | Gln | Val | Gly | Gly | Asp | Gly | Pro | Thr | His | Gln | Pro | Tyr | Asp | Gln | Leu |
| | 195 | | | | | | 200 | | | | | 205 | | | |
| Pro | Met | Leu | Arg | Ala | Ile | Glu | Asn | Val | Cys | Val | Phe | Arg | Pro | Cys | Asp |
| | 210 | | | | | 215 | | | | | 220 | | | | |
| Glu | Lys | Glu | Thr | Cys | Ala | Gly | Phe | Asn | Tyr | Gly | Leu | Leu | Ser | Gln | Asp |
| 225 | | | | | 230 | | | | | 235 | | | | | 240 |
| Gln | Thr | Thr | Val | Leu | Val | Leu | Thr | Arg | Gln | Pro | Leu | Lys | Ser | Ile | Asp |
| | | | 245 | | | | | | 250 | | | | | 255 | |
| Asn | Thr | Asp | Ser | Leu | Lys | Thr | Leu | Lys | Gly | Gly | Tyr | Ile | Leu | Leu | Asp |
| | | 260 | | | | | | 265 | | | | | 270 | | |
| Arg | Lys | Gln | Pro | Asp | Leu | Ile | Ile | Ala | Ala | Ser | Gly | Ser | Glu | Val | Gln |
| | | 275 | | | | | 280 | | | | | 285 | | | |
| Leu | Ala | Ile | Glu | Phe | Glu | Lys | Val | Leu | Thr | Lys | Gln | Asn | Val | Lys | Val |
| | 290 | | | | | 295 | | | | | 300 | | | | |

Arg Ile Leu Ser Val Pro Asn Ile Thr Leu Leu Leu Lys Gln Asp Glu
305 310 315 320

Lys Tyr Leu Lys Ser Leu Phe Asp Ala Asn Ser Ser Leu Ile Thr Ile
325 330 335

Glu Ala Ser Ser Ser Tyr Glu Trp Phe Cys Phe Lys Lys Tyr Val Lys
340 345 350

Asn His Ala His Leu Gly Ala Phe Ser Phe Gly Glu Ser Asp Asp Gly
355 360 365

Asp Lys Val Tyr Gln Gln Lys Gly Phe Asn Leu Glu Arg Leu Met Lys
370 375 380

Ile Phe Thr Ser Leu Arg Asn
385 390

<210> 10

<211> 316

<212> PRT

<213> Methanococcus jannaschii

<400> 10

Met Val Lys Leu Ser Gly Val Tyr Lys Gly Met Arg Lys Gly Tyr Gly
1 5 10 15

Glu Thr Leu Ile Glu Leu Gly Lys Lys Tyr Glu Asn Leu Val Val Leu
20 25 30

Asp Ala Asp Leu Ser Gly Ser Thr Gln Thr Ala Met Phe Ala Lys Glu
35 40 45

Phe Pro Glu Arg Phe Phe Asn Ala Gly Val Ala Glu Gln Asn Met Ile
50 55 60

Gly Met Ala Ala Gly Leu Ala Thr Thr Gly Lys Ile Val Phe Ala Ser
65 70 75 80

Ser Phe Ser Met Phe Ala Ser Gly Arg Ala Trp Glu Ile Ile Arg Asn
85 90 95

Leu Val Ala Tyr Pro Lys Leu Asn Val Lys Ile Val Ala Thr His Ala
100 105 110

Gly Ile Thr Val Gly Glu Asp Gly Ala Ser His Gln Met Cys Glu Asp
115 120 125

Ile Ala Ile Met Arg Ala Ile Pro Asn Met Val Val Ile Ala Pro Thr
130 135 140

Asp Tyr Tyr His Thr Lys Asn Val Ile Arg Thr Ile Ala Glu Tyr Lys
145 150 155 160

Gly Pro Val Tyr Val Arg Met Pro Arg Arg Asp Thr Glu Ile Ile Tyr
165 170 175

Glu Asn Glu Glu Glu Ala Thr Phe Glu Ile Gly Lys Gly Lys Ile Leu
 180 185 190
 Val Asp Gly Glu Asp Leu Thr Ile Ile Ala Thr Gly Glu Glu Val Pro
 195 200 205
 Glu Ala Leu Arg Ala Gly Glu Ile Leu Lys Glu Asn Gly Ile Ser Ala
 210 215 220
 Glu Ile Val Glu Met Ala Thr Ile Lys Pro Ile Asp Glu Glu Ile Ile
 225 230 235 240
 Lys Lys Ser Lys Asp Phe Val Val Thr Val Glu Asp His Ser Ile Ile
 245 250 255
 Gly Gly Leu Gly Gly Ala Val Ala Glu Val Ile Ala Ser Asn Gly Leu
 260 265 270
 Asn Lys Lys Leu Leu Arg Ile Gly Ile Asn Asp Val Phe Gly Arg Ser
 275 280 285
 Gly Lys Ala Asp Glu Leu Leu Lys Tyr Tyr Gly Leu Asp Gly Glu Ser
 290 295 300
 Ile Ala Lys Arg Ile Met Glu Glu Met Lys Lys Glu
 305 310 315

<210> 11

<211> 409

<212> PRT

<213> Bacillus thiaminolyticus

<400> 11

Met Ser Lys Val Lys Gly Phe Ile Tyr Lys Pro Leu Met Val Met Leu
 1 5 10 15
 Ala Leu Leu Leu Val Val Val Ser Pro Ala Gly Ala Gly Ala Ala His
 20 25 30
 Ser Asp Ala Ser Ser Asp Ile Thr Leu Lys Val Ala Ile Tyr Pro Tyr
 35 40 45
 Val Pro Asp Pro Ala Arg Phe Gln Ala Ala Val Leu Asp Gln Trp Gln
 50 55 60
 Arg Gln Glu Pro Gly Val Lys Leu Glu Phe Thr Asp Trp Asp Ser Tyr
 65 70 75 80
 Ser Ala Asp Pro Pro Asp Asp Leu Asp Val Phe Val Leu Asp Ser Ile
 85 90 95
 Phe Leu Ser His Phe Val Asp Ala Gly Tyr Leu Leu Pro Phe Gly Ser
 100 105 110
 Gln Asp Ile Asp Gln Ala Glu Asp Val Leu Pro Phe Ala Leu Gln Gly
 115 120 125

| | | | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Ala | Lys | Arg | Asn | Gly | Glu | Val | Tyr | Gly | Leu | Pro | Gln | Ile | Leu | Cys | Thr | 130 | 135 | 140 |
| Asn | Leu | Leu | Phe | Tyr | Arg | Lys | Gly | Asp | Leu | Lys | Ile | Gly | Gln | Val | Asp | 145 | 150 | 155 |
| Asn | Ile | Tyr | Glu | Leu | Tyr | Lys | Lys | Ile | Gly | Thr | Ser | His | Ser | Glu | Gln | 165 | 170 | 175 |
| Ile | Pro | Pro | Pro | Gln | Asn | Lys | Gly | Leu | Leu | Ile | Asn | Met | Ala | Gly | Gly | 180 | 185 | 190 |
| Thr | Thr | Lys | Ala | Ser | Met | Tyr | Leu | Glu | Ala | Leu | Ile | Asp | Val | Thr | Gly | 195 | 200 | 205 |
| Gln | Tyr | Thr | Glu | Tyr | Asp | Leu | Leu | Pro | Pro | Leu | Asp | Pro | Leu | Asn | Asp | 210 | 215 | 220 |
| Lys | Val | Ile | Arg | Gly | Leu | Arg | Leu | Leu | Ile | Asn | Met | Ala | Gly | Glu | Lys | 225 | 230 | 235 |
| Pro | Ser | Gln | Tyr | Val | Pro | Glu | Asp | Gly | Asp | Ala | Tyr | Val | Arg | Ala | Ser | 245 | 250 | 255 |
| Trp | Phe | Ala | Gln | Gly | Ser | Gly | Arg | Ala | Phe | Ile | Gly | Tyr | Ser | Glu | Ser | 260 | 265 | 270 |
| Met | Met | Arg | Met | Gly | Asp | Tyr | Ala | Glu | Gln | Val | Arg | Phe | Lys | Pro | Ile | 275 | 280 | 285 |
| Ser | Ser | Ser | Ala | Gly | Gln | Asp | Ile | Pro | Leu | Phe | Tyr | Ser | Asp | Val | Val | 290 | 295 | 300 |
| Ser | Val | Asn | Ser | Lys | Thr | Ala | His | Pro | Glu | Leu | Ala | Lys | Lys | Leu | Ala | 305 | 310 | 315 |
| Asn | Val | Met | Ala | Ser | Ala | Asp | Thr | Val | Glu | Gln | Ala | Leu | Arg | Pro | Gln | 325 | 330 | 335 |
| Ala | Asp | Gly | Gln | Tyr | Pro | Gln | Tyr | Leu | Leu | Pro | Ala | Arg | His | Gln | Val | 340 | 345 | 350 |
| Tyr | Glu | Ala | Leu | Met | Gln | Asp | Tyr | Pro | Ile | Tyr | Ser | Glu | Leu | Ala | Gln | 355 | 360 | 365 |
| Ile | Val | Asn | Lys | Pro | Ser | Asn | Arg | Val | Phe | Arg | Leu | Gly | Pro | Glu | Val | 370 | 375 | 380 |
| Arg | Thr | Trp | Leu | Lys | Asp | Ala | Lys | Gln | Val | Leu | Pro | Glu | Ala | Leu | Gly | 385 | 390 | 395 |
| Leu | Thr | Asp | Val | Ser | Ser | Leu | Ala | Ser | | | | | | | | 405 | | |

<210> 12

<211> 13

<212> PRT

<213> Naegleria gruberi

<400> 12

Ala Ser Asp Leu Pro Gln Ser Gly Asp Gln Val Asn Lys
1 5 10

<210> 13

<211> 12

<212> PRT

<213> Naegleria gruberi

<400> 13

Thr Ile Leu Asp Ser Thr Val Val Ala Ser Gln Arg
1 5 10

<210> 14

<211> 15

<212> PRT

<213> Naegleria gruberi

<400> 14

Ser Ser Asn Phe Tyr Ala Gln Leu Ser Gln Gln Phe Asp Ala Lys
1 5 10 15

<210> 15

<211> 16

<212> PRT

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Primer

<400> 15

Cys Ala Arg Trp Ser Ile Gly Gly His Gly Ala Tyr Cys Ala Arg Gly
1 5 10 15

<210> 16

<211> 17

<212> PRT

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Primer

<400> 16

Thr Thr Ile Gly Cys Arg Thr Cys Arg Ala Ala Tyr Thr Gly Tyr Thr
1 5 10 15

Gly

<210> 17

<211> 22

<212> DNA
 <213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Primer

<400> 17

tgtcggatat agtgaaagta'tg

22

<210> 18

<211> 22

<212> DNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Primer

<400> 18

aaccttttgc ttttcatcac ac

22

<210> 19

<211> 31

<212> DNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Primer

<400> 19

gagatataca tatgtccact caaccaaaga c

31

<210> 20

<211> 33

<212> DNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Primer

<400> 20

tatggatcct taaaggaatg gtctcaagac acc

33

<210> 21

<211> 27

<212> DNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Primer

<400> 21

caataaaaag tttgagctca agtattg

27

<210> 22
<211> 13
<212> PRT
<213> Naegleria gruberi

<400> 22
Val Tyr Gly Phe Pro Gln Tyr Leu Cys Ser Asn Phe Leu
1 5 10

<210> 23
<211> 6
<212> PRT
<213> Naegleria gruberi

<400> 23
Gly Tyr Ser Glu Ser Met
1 5